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Municipal policy priorities in three coastal communities in the Northeastern United States recognize effects of global climate change

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ABSTRACT

Coastal areas are confronted with a wide range of challenges stemming from their location at the land-sea interface. These challenges exist at a variety of spatial scales, and fall under the jurisdiction of governance authorities with responsibilities at different levels ranging from local to international. This study focuses on coastal environmental issues identified specifically at the municipal level. A policy landscape analysis of three communities in the Northeastern United States based on stakeholder interviews and review of local media, management plans, and government documents revealed several common challenges, including fisheries management, nutrient loading, and shoreline management. Despite these similarities, the relative importance of different issues varied from place to place. Major effects of climate change, such as sea level rise and increasing water temperatures, were not identified explicitly as priority issues by any of the three communities; however, climate change either directly causes or exacerbates many of the issues identified during the policy landscape analysis. Therefore, our study demonstrates that coastal communities in the region are already facing and addressing issues related to climate change. Our methodology provides an expedient approach for others to identify issues of coastal environmental concern in other communities. This can help determine the extent to which the similarities and differences in identified issues are common across broader geographic scales, and in particular whether effects of climate change are pervasive in coastal communities.

1. Introduction

People choose to live along the coastline for a multitude of reasons, including job opportunities, transportation preferences, aesthetics, and recreational options. In 2010, the United States Census Bureau reported that approximately 39% of the nation's population lives in coastal counties, and coastal populations are growing steadily (U.S. Census Bureau, 2010).

Despite the many benefits people associate with living near the water, coastal communities are facing a wide-range of challenges, including shoreline erosion (Kelly et al., 2011), sea level rise (Intergovernmental Panel on Climate Change, 2014), flooding (Dodson & Flinker et al., 2018), water pollution (Derraik, 2002; Howarth et al., 2002; Lotze et al., 2006), and natural resource degradation and depletion (Lotze et al., 2006). These challenges often arise due to the synchronicity of natural occurrences such as storms and land subsidence, and anthropogenic pressures, such as shoreside development and land use.

Further, while these challenges are sometimes caused and often felt at the local level, they also are complex and can be the result of larger regional and global processes such as climate change and shifting ocean currents (Cash et al., 2006). Conversely, changes in environmental features and anthropogenic forces at the local scale can potentially drive changes at larger scales (*e.g.,* shoreline hardening can disrupt larger sediment transport systems) (Miles et al., 2001).

Similar to the multi-scale nature of ecological dynamics, environmental management and policy-making also operate on multiple spatial scales, with several entities often having interests in or jurisdiction over a given area (Cash et al., 2006). As such, decisions by different entities may be guided by diverging policies, goals, timelines, and mandates, and may affect the efforts of others acting in the same area (Cash et al., 2006).

One complex layer of environmental decision-making that is often acutely felt, particularly at the municipal level, occurs when environmental issues must compete with other pressing needs related to local governance—such as education, affordable housing, and economic

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Fig. 1. Three Communities in Northeastern United States Analyzed in this Study.

development—for attention and resources. This competition can compromise the resources allocated for and attention dedicated to the broad range of pressing environmental issues (Smith et al., 2017), despite the fact that coastal municipalities are often heavily economically dependent upon natural resources (Martinez et al., 2007).

Academic analyses of environmental trends and consequent policy priorities are more often directed at large spatial scales. For example, recent perspectives on fisheries management span regional (*e.g.*, Kritzer et al., 2016), national (*e.g.*, Coleman et al., 2004), and global (*e.g.*, Costello et al., 2016) scales. This is likely due in part to the expectation that large scale studies will be relevant to wider audiences. This is a valid perspective, given that local scale ecological and policy dynamics are often enveloped within larger scale processes, such as climactic and oceanographic change (Wilbanks and Kates, 1999). However, while these analyses are critical to understanding the large scale dynamics at hand, more localized analyses provide an understanding of the many different ways in which large scale policies and ecological processes impact people, communities, and the environment at the municipal scale (Cash and Moser, 2000). Additionally, more localized analyses demonstrate the complexity of managing an ecological resource or responding to an ecological process when jurisdictional and ecological boundaries are not well-aligned (Cash and Moser, 2000).

To further the understanding of municipal experiences with multi-scale policies and ecological processes, we conducted a policy landscape analysis of three coastal communities in the Northeastern United States to identify the range of coastal environmental issues that each is addressing and to what degree the policy priorities reflect ecological dynamics. The results of this study highlight the top coastal environmental issues facing these three communities, and likely other communities throughout the Northeast and nationwide, and can provide strategies and guidance to policy makers and communities addressing similar issues. Additionally, the methodology presented in this paper can be applied to other coastal communities to gather information on 1) the similarities and differences in priority coastal environmental issues affecting each community, 2) the top concerns for each community's stakeholder groups, and 3) how these issues are communicated through media, plans, and other means.

2. Methods

2.1. Community profiles

We conducted the policy landscape analysis for Gloucester, Massachusetts; Chatham, Massachusetts; and East Hampton, New York (Fig. 1). We selected these communities because they all depend to some degree on maritime industries, especially commercial fishing, recreational fishing, and tourism, and because they differ in ways that might shape policy priorities and show contrasts, such as the economic and cultural importance of maritime industries, population size, extent of urbanization, and other factors (Table 1). The geographic variation among the three communities is significant as well, including differences in shoreline composition and orientation, geology and topography, and nearby habitats and biodiversity.

2.2. Research methodology

We conducted the analysis by first interviewing six to ten key stakeholders in each community either individually or in small focus groups of two to three participants. Initial interviewees included elected and appointed municipal officials and government staff having clear responsibilities for coastal resource management and development, followed by representatives of local and regional nongovernmental organizations and industry associations, and other citizen leaders. We identified interview candidates by chain referral from previous interviews, and by review of local media. The interviews occurred between August 2015 and January 2016.

The interviews were based on a series of open-ended questions. After providing an overview of the project purpose and goals,

Table 1
Geographical, sociological, and ecological characteristics of the selected municipalities.

	East Hampton, NY	Chatham, MA	Gloucester, MA
Size (square miles)	74.3	16.4	26.0
Location	Eastern half of South Fork on Long Island	Southeast corner of Cape Cod	North of Boston on Cape Ann
Population (U.S. Census Bureau, 2011–2015)	21,844 year-round (2015); 70,000 seasonal	6,126 year-round (2015); 25,000 seasonal	29,399 year-round (2015)
Median Household Income (U.S. Census Bureau, 2011–2015)	$81,715 (2015)	$67,587 (2015)	$61,505 (2015)
Level of development	Suburban	Rural	Urban
Ecological features	Bordered by water in three directions; beaches, including Atlantic Ocean beach (about 4833 feet); dunes, wetlands, coastal ponds, and inland freshwater ponds	Bordered by water in three directions; hilly and wooded uplands, barrier beaches and spits, harbors, small estuaries, wetlands, and salt and freshwater ponds	Rocky seacoast, harbors, beaches, dunes, estuaries, freshwater wetlands, forested uplands, and Annisquam River (about 4.5 miles long)
Economy and primary industries	Resort economy, tourism, hospitality, service, and retail; real estate, and fishing (Town of Easthampton, 2005)	Retail trade, service, fishing, construction, hospitality, banking, and real estate (Town of Chatham, 2003)	Commercial fishing and ocean-centric economy, tourism, arts, and technology (Gloucester Economic Development and Industrial Corporation, 2018)

interviewer(s) began each individual and focus group interview by asking the interviewee(s) to identify current and recent, *i.e.,* within the past two years, key coastal environmental issues in their communities. If the response seemed overly narrow, interviewees were prompted with general reference to typical topic areas, or coastal and marine resources and activities, while being careful not to lead the respondent. Subsequent open-ended questions solicited details on each issue identified, including information about the key participants, the processes by which the issues were being addressed (*e.g.*, through legal action or the annual town meeting), including timeframe and decisions, and strategies considered and/or implemented to address the issues (*e.g.*, policy changes, capital projects).

We also systematically reviewed local and regional newspapers for articles on coastal environmental topics to identify those issues receiving the most coverage. We searched the web-accessible archives of local and regional daily and weekly newspapers published between January 2014 and January 2016 using two separate methods dictated by the structure of the archived newspapers. When archived newspaper editions existed for viewing in their entirety, we reviewed each complete edition for articles related to ocean and coastal topics. For those papers that didn't allow for viewing entire editions at once, but allowed searching for individual articles, we used the search feature of each paper's website to identify articles on coastal environmental topics. The search terms included generic terms commonly associated with coastal environmental issues (*e.g.*, "erosion", "flooding", "invasive species") and specific search terms based on information gathered from the interviews, other newspaper articles, government documents, and management plans (*e.g.*, "beach stabilization", "shark", "Monomoy"). During this review, we cataloged each article and identified the main issues covered, key actors involved, and details about the decision-making process.

Concurrent with the newspaper review, we reviewed local board and committee meeting minutes, and local watershed, waterfront, and other types of environmental management plans. We considered any management plan that was still being used to guide local policy decisions at the time of the research. In these reviews, we identified the frequency with which different issues were addressed and noted any direct statements regarding their local importance.

We ranked and then combined the information gathered from all sources in order to determine the relative importance of the issues identified. More specifically, we ranked issues identified in the interviews based on the directly stated importance by the interviewees; issues identified in each newspaper based on the number of articles or opinion pieces (*i.e.*, columns or editorials) addressing each issue; and issues identified in management plans based on the number of focused plans dedicated to each issue and the number of times an issue was addressed within broader plans. Finally, we determined the overall rank of each issue by inversely weighting the rank given to the top four issues by each source and aggregating the scores. That is, we assigned four points to each number one ranking, three points to each number two, two points for each number three, and one point for each number four, then added the totals for each issue across all sources (Table 2). For each of the priority issues, we also documented how municipalities were addressing the issues (*e.g.*, through zoning, infrastructure, legal action), including key actors and timelines.

Table 2
Example scoring process for determining priority issues (*f = frequency with which the issue received this rank among the sources; score = frequency × weighting for that rank)*.

Rank		1	2	3	4	Totals	Rank
Weight		4	3	2	1		
Shoreline erosion	*f*	3	3	0	0	21	1
	score	12	9	0	0		
Nutrient management	*f*	2	2	2	0	18	2
	score	8	6	4	0		
Shoaling and dredging	*f*	2	0	2	2	14	3
	score	8	0	4	2		
Public access to waterways	*f*	2	2	0	0	14	3
	score	8	6	0	0		
Marine life conflicts	*f*	1	1	1	0	9	4
	score	4	3	2	0		
Coastal floodplain management	*f*	0	0	3	0	6	5
	score	0	0	6	0		
Fisheries	*f*	0	1	0	2	5	6
	score	0	3	0	2		

3. Results

3.1. Information sources

We interviewed and facilitated focus groups with 29 stakeholders across the three communities (Table 3). Participants and interviewees included municipal officials, members of regional planning agencies,

Table 3
Number of source type, by municipality.

Community	Interviewees/focus group members	Newspapers	Reports, plans, and other documents
Gloucester, MA	6	1	7
Chatham, MA	11	2	7
East Hampton, NY	12	2	11

Table 4
Prioritization matrix displaying the rank of coastal environmental issues in Gloucester, Massachusetts. Rank was determined based on score; 1 = high rank, 4 = low rank.

Issue	Stakeholders				Media	Plans	Score
	Municipal Officials	Commercial Fishers	Environmental/Community Advocacy	Nonprofit Education and Research	Gloucester Daily Times		
Coastal floodplain management	1	2	1	2	2	2	20
Fisheries		1		1	1	1	16
Shoaling and dredging		3	2				5
Nutrient management	2		3				5
Contamination of the inner harbor		4			4		2
Invasive species					3		2
Stormwater	3						2

Table 5
Prioritization matrix displaying the rank of coastal environmental issues in Chatham, Massachusetts. Rank was determined based on score; 1 = high rank, 4 = low rank.

Issue	Stakeholders						Media		Plans	Score
	Municipal Officials	Cape Cod Commission	Residents	Commercial Fishers	Environmental/ Community Advocacy	Business	Chatham Chronicle	Cape Cod Times		
Shoreline erosion	2	1	2		1			2		17
Nutrient management	1	2					3	1	2	16
Shoaling and dredging	4		3	1	4	1			3	14
Public access to waterways			1		2		2		1	14
Marine life conflicts				2			1	3		9
Fisheries				3		2	4	4		7
Coastal floodplain management	3	3			3					6

seasonal and full-time residents, coastal business owners, environmental professionals, members of the education and research community, commercial fishermen, municipal planning board and natural resource board members, and community advocates. In addition, we reviewed articles from five separate newspapers—one regional paper covering Gloucester, one regional and one local paper covering Chatham, and one regional and one local paper covering East Hampton. We also reviewed 25 separate plans and documents addressing coastal environmental issues. The document review was not exhaustive, but included town-wide plans (*e.g.*, comprehensive plans and economic development plans) and site or resource-specific plans (*e.g.*, wastewater plans, resource management plans, and municipal harbor plans).

3.2. Identification of priority issues

We identified a total of 12 priority coastal environmental issues, five of which were identified in more than one municipality (Table 7). We also identified additional issues, but they were not considered priorities per the ranking system used (*e.g.*, marine debris, ocean acidification). In some cases, those lower priority issues were enveloped within a larger issue (*e.g.*, ocean acidification affects fisheries issues identified in Gloucester). The issues identified in each category are described below, in order of priority.

3.2.1. Gloucester, Massachusetts

In Gloucester, Massachusetts we identified seven priority issues (Table 4):

a. Coastal floodplain management: Large portions of downtown Gloucester are located in a flood zone and various structures, including the wastewater treatment facility, are at risk of flooding from storm surge and extreme rain events.
b. Fisheries: As a fishing community, the city is addressing many different aspects of fishing, including changing regulations, at-sea monitoring requirements for groundfish vessels, the need for local lobster processing, aquaculture opportunities, shifting habitats associated with changes in water temperature, and marketing and innovation opportunities.
c. Shoaling and dredging: Shallow areas and shoals are impacting navigation, especially at low tide. This shoaling increases risks of

Table 6
Prioritization matrix displaying the rank of coastal environmental issues in East Hampton, NY. Rank was determined based on score; 1 = high rank, 4 = low rank.

Issue	Stakeholders					Media		Plans	Score
	Commercial Fishers	Environmental/ Community Advocacy	The Trustees of Reservations	Natural Resources Board	Planning Board	East Hampton Star	East Hampton Press		
Nutrient management	1	1	2	2	1	2	1	1	29
Shoreline protection and restoration	3	2	1	1	2	1	2	2	26
Coastal development		4	4		3	3	4	3	9
Fisheries	2		3			4	3		8
Mosquito control		3							2

Table 7
Summary of priority coastal environmental issues identified in each community. "X" indicates that the priority issue was identified in that community.

Priority Issue	Gloucester MA	Chatham, MA	East Hampton, NY
Coastal floodplain management/ development	X	X	X
Fisheries	X	X	X
Shoaling and dredging	X	X	
Nutrient management	X	X	X
Contamination of Inner Harbor	X		
Invasive species	X		
Stormwater	X		
Shoreline erosion		X	X
Public access		X	
Marine life conflicts		X	
Shoreline protection and restoration			X
Mosquito control			X

accidents to boaters, and also requires water-based emergency response personnel to take longer routes when responding to incidents.

d. Nutrient management: Nutrients from septic systems and fertilizer use are believed to cause local salt marsh decay and impact shellfish populations.
e. Contamination of the Inner Harbor: Gloucester's long history as a working port has been linked to environmental degradation of both the water column and the sediment.
f. Invasive species: Invasive green and blue crabs are competing with local species and impacting the surrounding ecosystem, including marshes and eelgrass beds.
g. Stormwater: Gloucester has been implementing measures to reduce pollution from stormwater for years, but anticipated regulatory changes from the Environmental Protection Agency raised concerns about how new requirements will be funded. Additionally, Gloucester is addressing stormwater from a number of industrial uses bordering the harbor.

3.2.2. Chatham, Massachusetts

In Chatham, Massachusetts we identified seven priority issues (Table 5):

a. Shoreline erosion: Coastal storms and relative sea level rise are the main causes of shoreline erosion in Chatham, and erosion is increasingly threatening the built environment and access to beaches and shellfish grounds. Erosion has amplified the debate between private property owners that favor shoreline hardening to protect their properties and public policy that favors natural storm damage protection and flood control functions of coastal landforms.
b. Nutrient management: Wastewater, stormwater, and fertilizer use are negatively impacting water quality in Chatham and present potential impacts to the seasonal economy and coastal property values.
c. Shoaling and dredging: Naturally shifting sands from tides, currents, and wind continuously reshape the bottom contours of Chatham's coves and harbors. This creates hazards to safe navigation, which particularly impacts fishing vessels, recreational boats, and vessels operated by the harbormaster and U.S. Coast Guard. Shoaling in the bays behind the barrier beach is exacerbated when the beach is breached and inlets allow higher energy water to enter the bay.
d. Public access to waterways: Chatham's resident and tourist populations continue to grow, resulting in landside and waterside congestion and impacts. More specifically, adequate parking, boat storage, and access to waterways are major issues within Chatham for fishermen, residents, and tourists alike. The problem is compounded by the loss of access points and associated parking due to erosion and storm activity.
e. Marine life conflicts: Seals are returning to Chatham waters in large numbers, preying on important commercial and recreational fish species such as cod, bluefish, and striped bass. Seals also attract white sharks to popular swimming beaches, and may impair water quality near haul-out sites.
f. Fisheries: Chatham's fishing industry is responding to regulations and monitoring, navigation hazards from shoaling, habitat alteration, and changing species distributions that make historically important species less available while increasing local abundance of other species.
g. Coastal floodplain management: Revisions to the Flood Insurance Rate Maps (FIRMs) in 2014 altered the geographic extent of Chatham's floodplain, requiring the Town to decide how to incorporate the new maps into wetland and zoning regulations.

3.2.3. East Hampton, New York

In East Hampton, New York we identified five priority issues (Table 6):

a. Nutrient management: Nutrient loading in East Hampton's fresh, brackish, and saline waters—from sources such as septic system effluent and fertilizer use—is causing negative impacts on the area's natural resources and local economy. Impacts are observed in the form of algal blooms, fish and turtle die-offs, and beach and shellfish closures.
b. Shoreline protection and restoration: Recent storm activity resulted in erosion and damage of beaches and dunes, increasing the vulnerability of coastal buildings and shorefront structures to the impacts of future storms and generating debate about the best way to reduce vulnerability.
c. Coastal development: East Hampton is experiencing growth and related development that is encroaching on and impacting natural resources such as wetlands, dunes, and beaches, and development is expanding into the floodplain.
d. Fisheries: Local fisheries are experiencing changes due to declines in traditionally important species, increasing interest in aquaculture, changing fisheries regulations, shoaling and related navigation hazards, and water quality issues.
e. Mosquito control: The County Department of Public Works conducted aerial sprays of methoprene to control the mosquito population and mosquito-borne viruses in East Hampton, NY, generating debate about the environmental impacts of spraying and best management practices to address mosquito control.

The issues common across all of the communities include shoreline management, which encompasses floodplain management, coastal development, and shoaling; nutrient management; and fisheries (Table 7).

3.3. Patterns in prioritization across communities, issues, and information sources

As the initial source of information in each community, stakeholder interviews and focus groups identified 18 out of the 19 priority issues; invasive species in Gloucester is a priority issue that was not raised by any stakeholders. The majority (14/18) of the stakeholder-identified issues were described as a priority by more than one stakeholder group. Issues prioritized by only one stakeholder group include marine life conflicts (Chatham), contamination of the inner harbor (Gloucester), stormwater (Gloucester), and mosquito control (East Hampton).

Newspaper articles identified 14 of the 19 priority issues. Shoaling and dredging (Gloucester), nutrient management (Gloucester), stormwater (Gloucester), coastal floodplain management (Chatham), and mosquito control (East Hampton) were not prominent in newspaper coverage, despite being identified as priorities by stakeholders.

No single coastal environmental issue in any community was identified as the top priority across all sources of information. However, in Gloucester and East Hampton, the top two priority issues in each community scored considerably higher than the other issues, suggesting some level of agreement among information sources. In Gloucester, coastal flood plain management and fisheries scored 20 and 16 respectively, whereas all other issues scored 5 or less (Table 4). In East Hampton, nutrient management and shoreline protection and restoration scored 29 and 26, while all other issues scored 9 or less (Table 6). In contrast, scores were much more even distributed across priority issues in Chatham (Table 5).

4. Discussion

Our results reveal several common coastal environmental issues in the three communities, which likely reflect challenges prevalent in other coastal communities in the Northeast and throughout the country. The causes of these issues are often complex, and could be the result of a variety of natural and/or anthropogenic factors, and small- and large-scale ecological processes. Additionally, while this study did not reveal climate change as a stand-alone priority issue, it is a large-scale phenomenon that either causes or exacerbates many of the identified priority issues that the communities are confronting.

4.1. Shared issues among communities

All three communities are facing and addressing issues related to shoreline management, nutrient management, and fisheries, as described in detail below.

4.1.1. Shoreline management

One of the greatest challenges in coastal communities is the movement of sediment. Shoreline erosion and the transportation and deposition of sediment by rivers and currents impact coastal development, floodplain management, and navigation (Wiggin et al., 2016; Labuz, 2015).

All three communities are working to limit the impacts of sediment dynamics on coastal development, natural resources, and public access. East Hampton and Chatham are particularly vulnerable to erosion as their primarily sandy shorelines are exposed to coastal storms and nor'easters, creating debate about the best means to address erosion. In Gloucester, the primarily rocky shore is also subject to erosion, although the problem is less acute than the other two communities and was not highlighted as an issue of primary importance.

Erosion is not the sole concern related to coastal development in these communities. Increased storm intensity (NOAA, 2016), in conjunction with sea level rise, also threatens coastal development due to increased risk of flooding (Intergovernmental Panel on Climate Change, 2014; McGranahan et al., 2007). All three communities currently experience flooding as a result of severe rainstorms and storm surge from extreme weather events, and all are working towards reducing their vulnerability to flooding and sea level rise.

For example, as a means to address both present and future erosion —despite opposition and litigation from a variety of organizations—federal, state, county, and local agencies decided to implement the Downtown Montauk Stabilization Plan in East Hampton. This emergency project, undertaken was as a one-time, stand-alone storm protection measure following the damage from Hurricane Sandy in 2012, entails placement of a sand-covered wall of sandbags along the shoreline to protect hotels and the downtown area. This project is only one of many components of the Fire Island to Montauk Point Reformulation Study (FIMP), a 50-year assessment of shoreline conditions from Fire Island Inlet to Montauk Point, which includes identifying, evaluating, and recommending long-term solutions for hurricane and storm damage reduction.

In Chatham, the 2014 revisions to the Flood Insurance Rate Maps (FIRMs) altered the geographic extent of Chatham's floodplain, requiring the Town to decide how to incorporate the new maps into wetland and zoning regulations. To address coastal floodplain vulnerability, new residential dwellings are now prohibited in the Conservancy District, which includes the 100-year floodplain, while existing dwellings are permitted to elevate to mitigate flood risk but must adhere to limits on height and substantial improvements.

In a similar effort in 2015, Gloucester adopted a new overlay district where special permits are required for residential construction. This special permit replaces the initial call for an outright ban on development in the overlay district.

Harbor sedimentation also affects the three communities, limiting the ability of commercial and recreational vessels to navigate efficiently and safely. The economic impacts of shoaling in a community can be significant, costing both time and money (*e.g.*, fuel expenses and wages of hourly employees) associated with wait times and the need to take alternate routes where transit options are limited or are tidally dependent (Wiggin et al., 2016). In addition to causing economic loss, shoaling can also cause safety concerns. In Gloucester and Chatham, sources identified shoaling and insufficient water depths as limiting factors for responding to an emergency on the water.

In Chatham, the Town worked with the U.S. Army Corps of Engineers and Massachusetts environmental agencies to develop a Town-wide Comprehensive Dredge and Dredged Material Disposal permit consolidating the permitting for the dredging of seven waterway sites and the disposal of dredge material at 17 disposal sites in the Town of Chatham.

4.1.2. Nutrient management

Water quality is central to the economy and culture of the three coastal communities in this study, and each community is working to minimize impacts of nutrient pollutants on its fresh, brackish, and saltwater resources. One of the primary concerns related to impaired water quality is algal blooms, which can cause a variety of problems including human and pet health issues, fish and turtle die-offs, loss of habitat, and forced migration of mobile marine animals. Another concern, identified primarily in Gloucester, is the loss of salt marsh habitat associated with poor root growth of marsh grass (Deegan et al., 2012). The sources of nutrients in all three communities included fertilizers, septic systems (and cesspools in East Hampton), and stormwater runoff.

To address the issue of nitrogen input from septic systems, Chatham initiated a Comprehensive Wastewater Management Planning (CWMP) Project, which identifies the wastewater problem areas, and provides a plan for wastewater treatment and recharge, and nitrogen management in Chatham, including the eventual sewering of the entire town at a cost of approximately $300 million. Chatham also promulgated Board of Health regulations that promote education, applicator certification, and standardization/regulation of fertilizer application to reduce the amount of nitrogen and phosphorus entering the town's wetlands and waterways.

In East Hampton, recommended and/or ongoing efforts to address the significant impact of nutrients (phosphorous and nitrogen) on water quality include: the installation of permeable reactive barriers, the use of vegetated swales and rain gardens, increasing flushing in ponds through dredging and culvert maintenance, sewering neighborhoods around vulnerable waterbodies, purchasing old houses in targeted locations to improve septic systems, installing regional/clustered wastewater treatment systems, using Community Preservation Funds to improve water quality, re-using effluent to water properties such as golf courses, developing and implementing septic system upgrade programs, conducting monitoring and research activities, and increasing public education and awareness.

4.1.3. Fisheries

In all three communities, commercial and recreational fishing is a significant part of the local economy. In recent years, fish landings have declined significantly. Many believe this is due to changing regulations,

environmental pollution and declining conditions, and variable stock abundance. It is important to note that, while the federal fishing regulations may limit catch, these respond to measured changes in abundance and aim to rebuild fish stocks.

To address declining fish catch, these communities are developing markets for less conventional species—including invasive species migrating north as waters warm and currents shift. The communities are also increasing aquaculture efforts, which in some cases can provide fishermen with an alternative or supplemental source of income. However, in East Hampton, some fishermen are resisting aquaculture development due to concern over potential fishing ground displacement and impacts to wild fish populations.

Gloucester continues to pursue projects that will aid in the development of marketing techniques to promote Gloucester seafood. In 2016, Gloucester was chosen by the White House's Rural Council to participate in the Local Foods, Local Places initiative. Through the program the city received technical support and advice from experts on methods for developing local food projects that in turn will encourage economic development, such as test kitchens, downtown food hubs, food business incubators, and food security outreach programs. The City received funding for its Gloucester Fresh Seafood Innovation Program from the Massachusetts Seaport Economic Council. The funds will help the City to expand its campaign to promote Gloucester seafood at a local, regional, and national level, including participation at the annual Seafood Expo North America Show and Boston Seafood Festival.

4.2. The effects of climate change on priority issues

Though not identified with sufficient frequency to be a stand-alone priority issue, climate change was and will continue to be a large-scale driver of many of the priority issues identified in this policy landscape analysis. The links between climate change and relevant priority issues identified in this study are described below.

4.2.1. Shoreline management

Warming waters, land subsidence, and changes in ocean circulation have caused a rise in sea levels of almost a foot in the Northeast since 1900 (U.S. Global Change Research Program, 2014). Additionally, mean precipitation rates in the Northeast have increased by approximately five inches (more than 10%) between 1895 and 2011 (U.S. Global Change Research Program, 2014) and inter-annual variability in precipitation has also changed significantly, with the Northeast experiencing a 70% increase in precipitation falling during heavy events between 1958 and 2010 (U.S. Global Change Research Program, 2014).

These changes in precipitation rates, coupled with rising sea levels and dangerous storm surges, are causing loss of habitat, erosion and flooding, and are fueling debates about how to protect coastal infrastructure in East Hampton and Chatham. Additionally, in Gloucester, there is concern about increased risk to existing infrastructure, including the wastewater facility. Communities are investigating how to address these risks to their shorelines and coastal infrastructure. As one example, Chatham has changed its Flood Insurance Rate Maps to address changing coastal floodplain vulnerability.

4.2.2. Nutrient management

Stormwater management and nutrient loading are rooted primarily in behavior of the local human population rather than activities at the global scale. However, increasing frequency and intensity of precipitation events as a result of climate change increase the volume of run-off and accelerate delivery of terrestrial nutrient sources into adjacent waters (Horton et al., 2014). There, nutrients can promote hypoxic and anoxic conditions in waters that are able to absorb less oxygen due to rising temperatures and reduced mixing (Hagy et al., 2004), as observed in East Hampton in the form of algal blooms and shellfish and turtle die-offs.

4.2.3. Fisheries

Some of the specific issues raised within the three coastal communities related to fisheries are seemingly not directly linked to climate change, such as disagreements with regulators over catch limits. However, climate-driven changes in biological productivity can compromise the performance of stock assessment models, and therefore the validity and effectiveness of management measures derived from those (*e.g.*, Pershing et al., 2015; Vaidyanathan, 2017; Burden et al., 2017). Furthermore, climate change is causing significant shifts in the distribution of many species (Nye et al., 2009; Pinsky et al., 2013; Kleisner et al., 2016), which creates new issues with the migration of non-native species, as described in Gloucester, and allocation of and access to target species, as described in all three communities.

4.3. Future application of this methodology

In addition to identifying the priority issues in these three coastal communities, the methodology reveals a strategy for future research. More specifically, we learned that when an issue is prominent in local debates, multiple sources are likely to identify its importance, as was the case with shoreline erosion in Chatham, floodplain management in Gloucester, and water quality in East Hampton. When prioritizing issues, however, different sources are likely to provide different perceptions of the broader landscape and relative prioritization of issues. We also found that priorities of different stakeholders were fairly predictable based upon the interests represented by each person or group.

Newspapers generally provided a complete and readily accessible picture of the policy landscape, covering topics of interest to a wide audience. However, the number of articles on a topic might not be the best representation of the topic's importance to the community. For example, some topics may appear in the newspapers more often than others because they are raised in multiple letters to the editor or are covered in multiple articles leading up to and following a specific event or meeting. This difference in perceptions and coverage demonstrates one of the values of analyzing a wide variety of relevant sources to obtain multiple data points to build a list of priorities, and cautions researchers to account for potential bias into any studies that implement the methodology described in this paper.

It is also important to note that this study captures a snapshot of coastal environmental issues of importance between the end of 2014 and beginning of 2016. It is possible that some of the issues identified would not rise to a high level of importance if the study was to be repeated in the future (see Smith et al., 2017). The most immediate reason for a potential shift in priority issues over time is likely to be a change in coastal environmental conditions, whereby new issues may emerge and old issues may become less prominent. Additionally, a municipality's economic and social conditions also will fluctuate over time and, as a result, affect the overall importance of coastal environmental issues relative to each other and relative to other needs important to local governance.

A potential shift in priority issues also may be explained in terms of the “issue-attention cycle” described by Downs (1972). There are five stages of the cycle including (1) the “pre-problem stage”, in which a condition exists but is not yet widely acknowledged or noticed, (2) the “alarmed discovery and euphoric enthusiasm” stage, in which a series of events or some other cause elevates awareness of and alarm about the issue and promotes confident efforts to address the issue, (3) the “realizing the cost of significant progress” stage, which shows the economic and social costs associated with trying to address the issue, (4) the “gradual decline of intense public interest” stage, during which fear, boredom, discouragement, and other feelings push the issue out of the spotlight, and (5) the “post-problem” stage, in which the issue “moves into pro-longed limbo” and new issues capture public concern. The methodology used in this study likely captured issues in stages two and three of the issue-attention-cycle. Given the fluid nature of attention toward issues, a future policy landscape analysis of these three

communities would likely yield a modified suite of priority issues.

5. Conclusion

Coastal environmental issues are among the many needs competing for municipal resources, and while several coastal environmental issues may be pressing and have significant implications for a town's economy and safety, they cannot all be priorities. To obtain an understanding of the types of issues currently important to coastal municipalities in the Northeastern United States, we conducted a policy landscape analysis of three coastal communities: Gloucester, MA, Chatham, MA, and East Hampton, NY. The policy landscape analysis revealed the complex suite of coastal environmental issues important in each community between the end of 2014 and the beginning of 2016.

Coastal floodplain management, nutrient management, and fisheries issues were main concerns for all three communities and, although climate change did not rise to priority status as its own topic, it influences many of the priority issues identified in this policy landscape analysis.

This study provides an analysis of issues at a specific point in time in a limited number of communities. However the methodology tested in this study can be used by municipalities, policy makers, and others to better understand priority issues of other communities at a given time. As coastal communities and policy makers continue to respond to environmental issues, especially those influenced by climate change, identifying similarly affected communities can help generate potential larger scale or collaborative response and mitigation strategies more effectively and cost-efficiently.

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